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ABSTRACT

This curriculum guide consists of nine modules on signal wiring, one of the three divisions of the standardized trade electricity curriculum in high schools in New York City. The modules cover the following subjects: bells, double contact pushbuttons, annunciator circuits, open circuit burglar alarms, closed circuit burglar alarms, fire alarms, telephones, basic electronics (solid state), and wiring in raceway. Each unit is comprised of performance objectives and tasks to meet the performance objectives, keyed to teaching content. Teaching content is offered in a three-column arrangement listing tasks, development of technical skills, and development of related information (reinforcement of basic skills). Some of the units include line drawings. A section that provides suggestions for integrating basic skills instruction with the technical content also is offered. Appendixes to the guide contain a bibliography, a sample lesson plan, and a blank student evaluation report. (KC)

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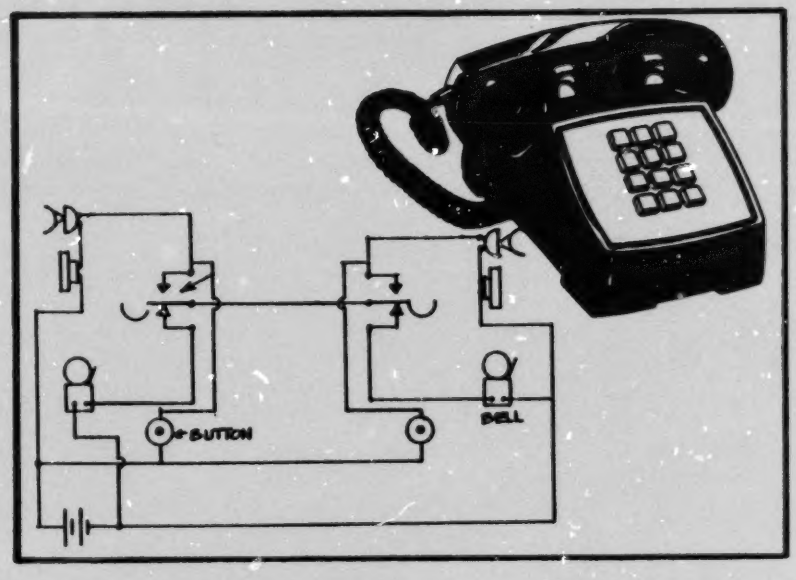
TRADE ELECTRICITY
SIGNAL WIRING LEVEL 1
STANDARDIZED CURRICULUM



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Foreword

A Standardized Curriculum in Trade Electricity - Signal Wiring is designed to provide vocational training for young persons of high school age who have shown an aptitude for the electrical trades and have expressed a desire to enter the field of electrical trades. This curriculum also may be used fully or in part in alternate programs, such as Shared Instruction and After School Occupational Skills. In addition, individual modules can be used in special education programs and adult occupational training.

The content has been organized into three major divisions: Signal Wiring - Level One; Lighting - Level Two; Motors and Controls - Level Three. Each division contains a number of specific modules with several jobs within each module. The entire curriculum is designed to be taught in 1200 hours. The third division is comprised of several optional modules enabling schools to select modules which best suit their needs, fully or in part.

The aim of the total curriculum is to provide a broad foundation of basic skills and information to enable interested students to enter the electrical industry as workers and to pursue advanced training.

Acknowledgments

The Standardized Trade Electricity Curriculum, Signal Wiring - Level One for the New York City High Schools was developed during the OCE 1981 Summer Curriculum Project. The project was initiated by the Office of Occupational and Career Education, George R. Quarles, Chief Administrator; Dr. Howard Friedman, Deputy Administrator; and Mary Gaskin, Director of Support Services. The development of instructional guides for standardizing vocational programs was under the direction of the Bureau of Trade and Technical Education, John B. Vitale, Assistant Director and the Occupational Curriculum Unit, Anne McCarthy, Consultant.

Overall supervision was provided by the Occupational Curriculum Unit, Jack H. Dixon, Coordinator, with the assistance of Dr. Arthur Golomb, Curriculum Specialist and Brenda Fryson, Basic Skills Specialist.

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The bulletin was reviewed and prepared for printing by members of the Editorial/Production Unit of the Office of Curriculum Development and Support, Dr. Morris Freedman, Director. OCDS is a part of the Division of Curriculum and Instruction, Charlotte Frank, Executive Director.

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BASIC SKILLS

SUGGESTIONS

FOR IMPLEMENTATION

STRATEGIES FOR REINFORCING RELATED MATHEMATICS, READING AND COMMUNICATION SKILLS THROUGH OCCUPATIONAL EDUCATION

REINFORCING RELATED BASIC SKILLS

Increased employer demands, coupled with fierce competition for employment in many occupational areas, have made it vital that students moving into the job arena be totally prepared to obtain and hold jobs. The experienced vocational instructor has long understood that preparation for the job market does not end with the development of hands-on skills. The incorporation of related reading, communications and mathematics skills into the Trade Electricity course of study represents a comprehensive approach to teaching which will enhance opportunities for future job success.

The strategies and activities which can be designed for the purpose of basic skills reinforcement are limited only by the imagination of the individual instructor. Each instructor must decide, based upon the needs of his/her students, what methods work best. Traditional student participatory activities such as preparing reports, viewing films, taking field trips, planning and completing electrical projects, all present opportunities for basic skills reinforcement.

This curriculum guide in Trade Electricity clearly outlines the hands-on operations which should be covered during the course work. The second and third columns of this guide also include references to tasks which require a certain level of competency in mathematics, reading and communications, if the student is to fully grasp the course content. The items provide opportunity for REVIEW and PRACTICE of related basic skills within the confines of the shop setting.

The instructor of trade electricity can use these topics and subtopics to build basic skills activities into daily lessons. It is important to note that the primary responsibility for TEACHING academic competencies rests with the teachers of those subjects. However, the concept of REINFORCEMENT allows the teacher of Trade Electricity to focus on those reading, mathematics and communications skills which relate directly to the trade area.

The concept of reinforcement encompasses the two types of teaching strategies mentioned earlier: REVIEW and PRACTICE.

Review

Basic skills review exercises in the electrical shop setting can take the form of "mini-lessons" which can be presented as an integral part of class sessions devoted to "shop theory" or "related technical information." These activities should be planned in conjunction with the development of the hands-on skills.

A review of the Trade Electricity course of study will reveal mathematics, reading and communication skills which will help to maximize student performance or understanding of a particular task or topic. Each of these skills can then be reinforced at the most appropriate times during the course work. For example, a review of Ohm's Law may also involve a review of:

-problem-solving techniques
-methods of working with formulas
-multiplication and division of fractions

These math skills can again be reviewed when other electrical formulas are introduced.

Examples of Related Basic Skills Review Activities

Review Ohm's Law Discuss how to calculate voltage drop in a series circuit E = I x R	Review reading skills: reading and understanding technical data Develop hints for interpreting technical data Examples: -Look up any unfamiliar words -Try to put complicated passages into your own words.

Practice

Practice exercises provide opportunity for the student to develop and examine the skill which has been reviewed during the class session. Here are some examples of the types of activities which encompass both basic skills reinforcement and job preparation:

.using the correct names of tools and machines while performing hands-on operations

.using actual materials (metal, wood, etc.) for accurate measuring

.using order forms and message blanks to reinforce spelling and writing skills

.using sample civil service examinations to improve test-taking techniques

.using proofreading methods to check sentence structure and punctuation

With the increased emphasis on strengthening basic skills, many teachers have begun to compile comprehensive files of worksheets/assignment sheets which they use in a variety of teaching situations. These exercises often are used for homework assignments, student assessment or classroom practice.

The two assignment sheets which follow illustrate how information related directly to the electrical trades can be used to develop student worksheets which help to reinforce basic skills. In the first example, the student clearly sees that ability to read and interpret information presented in chart form is a job-related skill which must be mastered. The second assignment sheet reminds the student of the importance of systematic note-taking in the classroom as well as in some on-the-job situations.

Sample Assignment Sheet

TRADE ABBREVIATIONS AND SYMBOLS

As you have seen, many abbreviations and symbols are used in the electrical trade. You must be familiar with these abbreviations and symbols and know how to write them correctly if you plan to work in this field.

DIRECTIONS: Complete the exercise by filling in the missing information. Double-check your work from your classroom notes.

	TERM	ABBREVIATION/SYMBOL
1.	Direct Current	_____
2.	National Electral Code	_____
3.	Constant Ringing Drop	_____
4.	Kilowatt	_____
5.	Volt	_____
6.	Horsepower	_____
7.	Holding Coil	_____
8.	Open Coil	_____
9.	Grounded Coil	_____
10.	Shorted Coil	_____

Sample Assignment Sheet

FUEL WASTE DUE TO HIGH NIGHT SETTINGS

DIRECTIONS: Study the information presented in the chart. Answer each question by referring to the data in the chart

FUEL WASTE DUE TO HIGH NIGHT SETTINGS

Lowered Night Temperature degrees F	Savings in Oil (per cent) when Temperature is Lowered at Night			
	4 hours	8 hours	12 hours	16 hours
70	0	0	0	0
65	2.5	5	7.5	9.5
60	5	9.5	14.5	19.5
55	7.5	14.5	21.5	28.5
50	9.5	19.5	28.5	38.5

1. When the night temperature is lowered to 60° for 8 hours what percentage of oil is saved?_____.
2. What is the difference in savings for 4 hour period when the temperature is set at 65° and 55°? _____.
3. A 21.5% savings in oil can be realized when the temperature is set at_____degrees F for_____hours.
4. When the night temperature is lowered to 55° for 12 hours, there is a_____% savings in oil.
5. Why do you think there is no oil savings when the temperature is set at 70°F? (Answer in a complete sentence) _____

_____.

BASIC SKILLS OVERVIEW

For purposes of establishing a workable and realistic teaching framework for the instructor, basic skills may be defined as those reading, mathematics and communication skills which are essential to:

-the student's overall understanding of the tasks, knowledges and appreciations which form the the course of study

-the student's ability to eventually perform satisfactorily as a worker in a job setting.

-the student's ability to pass:

Standardized academic examinations
Occupational licensing examinations

Specifically, these skills may be viewed within the following broad categories:

-READING COMPREHENSION

-VOCABULARY DEVELOPMENT

-COMMUNICATIONS

-WRITING
-SPEAKING and LISTENING

-MATHEMATICS

The chart on the following page lists several subskills under each broad category. These subskills denote areas in which reinforcement would be most pertinent to students enrolled in vocational courses. Following the chart are discussions of each of the major basic skills categories and methods by which these subskills can be presented for review and practice throughout the course.

RELATED BASIC SKILLS

READING COMPREHENSION SKILLS

Understanding written directions
Reading for location of specific details
Reading for understanding of overall concept or idea
Reading to infer meaning
Learning technical terms
Learning to sound out words
Learning word parts (related roots, prefixes and suffixes)

MATHEMATICS SKILLS

Counting
Adding whole numbers, fractions, decimals
Subtracting whole numbers, fractions, decimals
Multiplying whole numbers, fractions, decimals
Dividing whole numbers, fractions, decimals
Problem-solving (using equations, formulas, geometric principles)
Problem-solving (understanding related word problems
Understanding the metric system

WRITING SKILLS

Using correct capitalization and punctuation
Understanding sentence structure (basic grammatical concepts)
Using technical terms
Learning helpful spelling rules
Learning to sound out words
Using the dictionary

SPEAKING AND LISTENING SKILLS

Using standard English
Practicing appropriate voice volume
Relating and receiving directions
Relating and receiving specific details
Interpreting information and meaning
Drawing conclusions
Relating and receiving non-verbal messages
Using technical terms

Writing Skills

By emphasizing the mechanics of spelling, punctuation, word usage and sentence structure in a variety of simulated work-related situations, the instructor will be able to help students understand the practicality of what they often perceive as an abstract notion which has no meaning in the real world.

Each pre-vocational and occupational subject will require a different level of proficiency with respect to writing skills. As needs arise, practice can be given with particular rules that are used frequently. Thus, the instructor must make an initial analysis of the writing skills which are required for adequate job performance in the electrical trades. There are, however, common areas of student deficiency, which include the inability to:

-Compose complete sentences

-Use words correctly in sentences (grammar)

-Use words appropriately (including technical terms)

-Spell words correctly

-Punctuate sentences correctly

-Write legibly

Improvement in these area is based upon the systematic inclusion of these skills in classroom activities. The use of actual materials such as order blanks, sales slips, work orders and bills of materials will require the student to apply basic writing standards to job-related situations. If students understand from the outset that all written work will be checked for adherence to these standards, they will be more conscious of not only what they write, but how they write it.

Reading Comprehension

The advantage of having available printed material which is of high student interest is an invaluable aid in the reinforcement of reading comprehension skills. Those students who have experienced difficulties with reading in other areas can be motivated and provided with numerous opportunities for achievement. Other students will be fascinated with the variety of reading materials which are pertient to the electrical trades.

Textbook passages, professional journals, catalogs and schematic drawings are examples of the types of reading materials which may be used. From these, reading comprehension exercises which emphasize specific skill reinforcement may be developed.

Several strategies can be utilized to assist in strengthening reading competencies:

-Emphasizing the importance of improving specific comprehension skills
-Using a wide variety of printed materials, including schematic drawings and municipal codes
-Constructing a variety of comprehension questions which are keyed to related reading materials
-Introducing unfamiliar terms prior to making a reading assignment
-Assigning short reading passages for thorough understanding
-Reviewing basic components of electrical codes and other standard references
-Emphasizing good study skills
-Emphasizing concise note-taking

Vocabulary Development

Each professional area has its own unique set of terms. These are highly specialized words and phrases which are peculiar to the particular profession. Mastery of these terms contributes directly to a more thorough understanding of the course work.

It is suggested that terms related to the electrical trades be used as the basis for the development of individual notebook glossaries. Thus, as new topics are presented, the related vocabulary is introduced as an integral part of the overall lessons. It is more effective to explore six or seven new words or phrases within the context of a skills lesson than to present twenty or thirty such terms in an isolated and unrelated learning situation. The systematic building of a notebook glossary allows the instructor to easily review key terms and to reinforce spelling, pronunciation and usage (oral and written).

As a result of this approach to new terminology, the instructor will find it possible to emphasize more general areas of vocabulary development. These include:

-Recognition of common prefixes, suffixes and roots
-Division of complex words into syllables
-Identification of commonalities in spelling
-Use of the dictionary and other reference materials

(Here, the student is encouraged to decide upon the meaning of an unfamiliar word based upon his/her knowledge of other words in the sentence.)

Oral Communications (Speaking and Listening)

Perhaps the most overlooked components in the basic skills compendium are the speaking and listening skills. Yet, competency in these areas is critical to future job success. Additionally, the very nature of the learning activities requires students to employ these critical skills.

By building an awareness of common errors and focusing on the dynamics involved, the instructor can assist in developing solid communication skills. For example, following oral directions is an activity which is a fundamental component of the teaching/learning process. This process includes several clearly defined steps which can be presented for review and practice. They are:

-Listening to and interpreting the entire explanation

-Understanding and determining the steps involved

-Completing and checking each step before proceeding to the next

-Verifying (checking) the entire action taken and the results obtained

Classroom simulations which approximate actual on-the-job situations lend excitement and realism to the systematic practice which is neccessary for achievement in this area. These activities can be enhanced by use of the tape recorder and video tapes which allows the students to hear and see themselves in various situations. Even more germane to student performance is the example set by the instructor. By stressing acceptable English, speaking slowly and distinctly and responding carefully to questions, the teacher sets the standards which will carry over into other life experiences.

Mathematics Skills

Instruction which draws on realistic settings and problems in strengthening computational skills helps students transfer this learning to new situations. Additionally, the realization that most students will eventually become workers, taxpayers and consumers, opens up a wide range of possibilities for demonstrating the importance and practicality of possessing a sound background in mathematics.

Many students exhibit a fear of mathematics. The exploration of mathematical concepts and operations in the electrical shop can provide them with opportunities for achievement in an area of critical need.

The key to student achievement is the presentation of the skills in easily manageable components. The use of teacher-made assignment sheets and/or career-oriented workbooks is an effective means of practice and review which need not detract from classroom time.

Mathematical operations lend themselves to efficient division into subskills which can be explored as a part of the total lesson. The following suggestions may assist the instructor in the reinforcement of a related computational skill.

-Present the concept within the context of a vocationally-related-application
-Review the fundamental steps in the operation
-Provide opportunity for group discussion and practice
-Provide assignments which include vocationally-related word problems

This basic skills checklist will help in the identification of discreet subskills and on-the-job applications which are most relevant to Trade Electricity.

Basic Skills Checklist

Trade Electricity

1. What specific math skills should be emphasized during the teaching of this course?

   ( ) Adding whole numbers_____fractions_____decimals_____

   ( ) Subtracting whole numbers_____fractions_____decimals_____

   ( ) Multiplying of whole numbers_____fractions_____decimals_____

   ( ) Dividing of whole numbers_____fractions_____decimals_____

   ( ) Using equations and formulas

   ( ) Understanding geometric principles (angles, volume, area)

   ( ) Other

   _____

   _____

2. What measuring instruments or devices are used in this occupational area?
   (Examples: ruler, micrometer, voltmeter)

   _____ _____ _____

   _____ _____ _____

3. What actual on-the-job applications of math skills in this occupational area should be emphasized during the teaching of this course?
   (Examples: measuring wire, computing sales tax, calculating bills of materials)

   _____

   _____

4. What specific reading skills should be emphasized during the teaching of this course?

( ) Understanding written directions
( ) Reading charts and schematic drawings
( ) Identifying and interpreting specific details
( ) Determining meanings of unfamiliar technical terms
( ) Understanding trade abbreviations and symbols
( ) Other

_____

_____

5. What teaching strategies for improving reading comprehension skills could be incorporated into the teaching of this course?

( ) Use of textbook
( ) Use of job sheets
( ) Other
( ) Use of information sheets
( ) Use of newspapers and trade journals
( ) Use of manufacturer's specifications

_____

_____

_____

6. What actual on-the-job applications of reading and communication (written and oral) skills in this occupational area should be emphasized during the teaching of this course?

( ) Reading manuals
( ) Using standard references
( ) Writing orders
( ) Talking to customers
( ) Other
( ) Writing complete sentences
( ) Using correct punctuation
( ) Capitalizing in abbreviations and sentences

_____ _____

_____ _____

_____ _____

Unit I: Bells

Level One: Signal Wiring
Suggested Time: *100 Hours / 150 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install and connect a simple door bell system.
- Install one bell and one buzzer, each controlled by its own pushbutton.
- Install a factory emergency signal system where three bells connected in parallel can be operated from any of three emergency buttons.
- Install a three-station selective call system where each station can signal either of the other two, using two-point lever switches.
- Install a signal system for a two-family house with front and rear entrances; whereby front door buttons will operate bells in kitchen while rear button operates a buzzer; and buttons in kitchen will operate front and rear doors.

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
1. Install and connect a simple doorbell system.	A. Develop basic electric circuit on chalkboard, using bell, button, and battery. (See Fig. #1) B. Demonstrate mounting of equipment. 1. Start screw with scratch awl. 2. Drive screw with screwdriver. 3. Measure distances using six-foot folding rule. C. Demonstrate job wiring 1. Cut and strip conductor with wire stripper. 2. Fasten wires to surfaces with staples or wood screws. 3. Make terminal connections. D. Demonstrate job testing. 1. Connect to power source. 2. Operate circuit E. Stress safety precautions.	A. Explain and illustrate schematic symbols. B. Discuss methods of fastening wires. C. List circuit components 1. Bell 2. Button 3. Chimes D. Discuss wiring terms 1. Bell-battery wire 2. Button-battery wire 3. Section wire

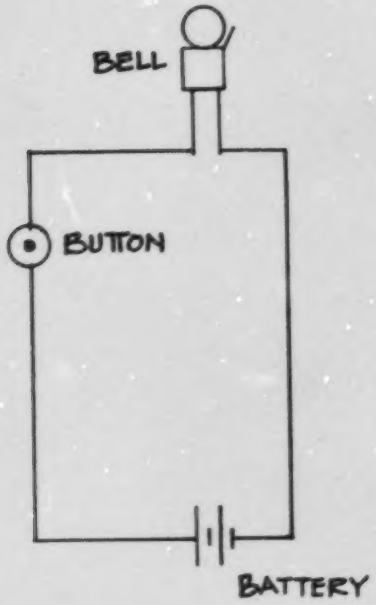


Fig. # 1

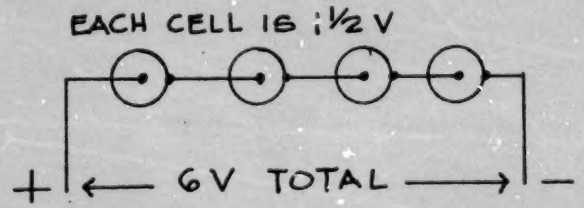
2. Install two bells in parallel operated from one pushbutton.	A. Develop job circuit on chalkboard. 1. Show parallel connection of two bells B. Review mounting of equipment. C. Review job wiring D. Demonstrate Western Union splice. E. Review testing procedures.	A. Discuss parallel circuits 1 Advantages 2. Voltage distribution 3. Current flow B. Discuss types of splices 1. Western Union 2. Tee 3. Rattail
3. Install one bell operated by two pushbuttons.	A. Develop job circuit on chalkboard. 1. Show parallel connection of buttons. 2. Trace current flow. B. Review mounting of equipment. C. Review job wiring. D. Review testing procedures.	A. Discuss conductors used for signal wiring. 1. Types 2. Sizes 3. Insulation B. Discuss multiple button connections.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
4. Install one bell and one buzzer, each controlled by its own pushbutton.	A. Develop basic circuit on chalkboard. 1. Show how the circuit is a combination of two simple circuits. 2. Trace current flow through separate paths 3. Show how each circuit must work independently of the other. B. Review mounting of equipment. C. Review job wiring D. Review testing procedure	A. Describe construction and operation of bells and buzzers. B. Discuss principles of electromagnets.
5. Install two bells in series operated by one pushbutton.	A. Develop job circuit on chalkboard. 1. Define series connections as applied to circuits(one path). 2. Show how operation of each bell is dependent on the other 3. Point out reduced audibility of series connected bells. 4. Show how an opening in the circuit affects entire circuit operation. B. Review mounting of equipment. C. Review job wiring. D. Review job testing.	Discuss series circuits. 1. Voltage distribution 2. Flow of current 3. Disadvantages 4. Applications

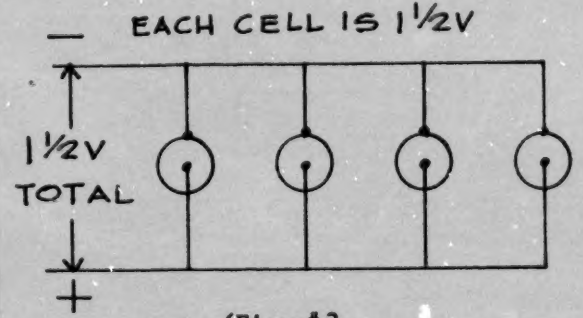
6. Install two bells in series, operated by two pushbuttons in parallel.

A. Develop job circuit on chalkboard.
B. Review mounting of equipment.
C. Review job wiring.
D. Test job for proper operation.
   1. Operate both bells from either button.

Discuss dry cells
1. Construction
2. Theory of operation
3. Increasing voltage by connecting in series. (See Fig. #2)
4. Increasing current capacity by connecting in parallel. (See Fig. #3)



(Fig. #2



(Fig. #3

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Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
7. Install a signal system consisting of three bells operated independently from three push buttons.	A. Develop a job circuit on chalkboard. 1. Show how the circuit is a comibination of three simple circuits. 2. Show how each circuit must operate independenly of the others B. Review mounting of equipment C. Review job wiring procedures D. Test job for proper operation	Discuss power sources 1. Batteries a) Wet cells b) Dry cells 2. Transformers a) Step up b) Step down 3. Generators a) Steam b) Diesel c) Wind d) Water
8. Install a factory emergency signal system where three bells connected in parallel can be operated from any of three emergency buttons.	A. Develop job circuit on chalkboard. B. Review parallel connection of bells and buttons. C. Review mounting of equipment. D. Review job wiring procedure. E. Demonstrate pig tail splice. F. Test job for proper operation.	Define voltmeter, ammeter, ohmmeter 1. Construction 2. Operation 3. Use in circuits

9. Install a four-wire return call system for two offices.	A. Develop job circuit on chalkboard. B. Demonstrate how station A can ring station B and station B can ring station A. C. Review mounting of equipment. D. Review job wiring procedures. E. Test job for proper operation.	Discuss factors affecting resistance of wires. 1. Length 2. Material 3. Cross-sectional area 4. Temperature
10. Install a three-wire return call system between two apartments.	A. Develop job circuit on chalkboard. B. Demonstrate how wire is saved by this connection. C. Review mounting of equipment. D. Review job wiring procedures. E. Test job for proper operation.	Discuss Ohm's Law 1. Relationship between voltage and current 2. Relationship between resistance and current

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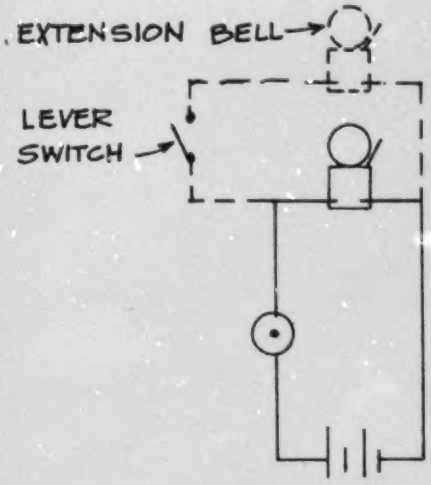
Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
11. Install a multi-station selective return call system in a three-story building in which each floor can signal the other floors.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	Discuss code regulations for signal systems: 1. Wire sizes 2. Conductors 3. Proximity to higher voltages
12. Install an extension bell to an existing bell circuit which may be disconnected by a lever switch.	A. Develop job circuit on chalkboard. (See Fig. #4) 1. Demonstrate operation of lever switch 2. Show how extension bell rings only when lever switch is closed. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	Discuss construction and operation of switches. 1. Lever switches 2. Toggle switches 3. Knife switches 4. Canopy switches



(Fig. #4

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13. Install two bells in series operated from one button, one of which can be shunted out with a lever switch.

A. Develop job circuit on chalkboard.
   1. Point out change in voltage across remaining bell when one bell is shunted out.
   2. Review voltage distribution in series circuits.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation.

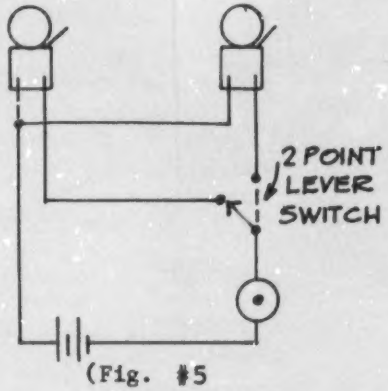
Discuss how to calculate voltage drop in a series circuit.
1. $E = I \times R$
2. Work out examples.

14. Install three bells in series controlled from one button, in which two of the bells can be shunted out individually by use of two lever switches .

A. Develop job circuit on chalkboard.
   1. Point out need for two lever switches on this job.
   2. Demonstrate shunting out one bell.
   3. Demonstrate shunting out two bells.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation.

Demonstrate how to calculate total current in a circuit.

1. $I = \frac{E}{R}$
2. Work out examples.

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
15. Install a two-station selective call system using a two-point lever switch.  (Fig. #5	A. Develop job circuit on chalkboard. (Fig. #5). 1. Show how a two-point lever switch provides selectivity. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	Demonstrate how to calculate total resistance of a circuit. 1. $R = \frac{E}{I}$ 2. Work out examples.
16. Install a three-station selective call system where each station can signal either of the other two using two-point lever switches.	A. Develop job circuit on chalkboard. 1. Show circuit selectivity available with two-point lever switch. 2. Demonstrate how to signal each individual circuit through lever switches. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Discuss ampacity of conductors. 1. Size of wire 2. Material B. Review conductor insulation requirements.

17. Install a simple signal system with an emergency battery source. Use a two-point lever switch to battery.	A. Develop job circuit on chalkboard. 1. Emphasize how selection of power source is achieved by use of two-point lever switch. 2. Show how to check circuit from both power sources. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Discuss emergency power sources 1. Need for emergency power sources 2. Types 3. Applications 4. Maintenance procedures B. Review battery construction.
18. Install a three-wire return call system with an extension bell and a cut out switch at one location.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of single pole, single throw switch. 2. Compare S.P.S.T. to lever switch B. Review mounting of equipment. C. Review job wiring procedures. D. Test for correct operation with extension bell in circuit and out of circuit.	A. Discuss code regulations for knife switches. 1. Connections 2. Construction specifications 3. Enclosures 4. Position 5. Ratings

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
19. Install a three-station selective ringing circuit with a three-point lever switch for circuit selection.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of three-point lever switch. 2. Point out circuit selectivity by use of switch. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of each individual branch.	Discuss code regulation regarding wiring methods for signal systems. 1. Enclosures 2. Grounding 3. Conductor sizes 4. Physical protection
20. Install a simple signal system with double-pole, single-throw switch to disconnect circuit from source of supply.	A. Develop job circuit on chalkboard 1. Demonstrate operation of D.P.S.T. switch. 2. Show how switch opens both lines of circuit. B. Review mounting procedures. C. Review job wiring procedures. D. Test for proper operation.	Discuss code requirements for overcurrent protection in signal systems. 1. Location 2. Ratings

21. Install a simple signal system with an emergency source of supply controlled by a single pole, double throw switch.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of S.P.D.T. switch. 2. Compare operation of S.P.D.T. to two-point lever switch. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. 1. Regular source 2. Emergency source	Discuss preparation of bill of materials for a typical signal installation. 1. Length of wire runs 2. Type, size, and number of conductors. 3. Equipment required.
22. Install a simple signal system with an emergency power source controlled by a double pole, double throw switch.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of D.P.D.T. switch. 2. Compare to other types. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. 1. Regular source 2. Emergency source	Discuss procedure to calculate costs for job materials on a signal installation. 1. Use of price catalogs 2. Trade discounts 3. Arriving at a total cost

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
23. Install a signal system for a two-family house, providing each apartment with a bell and a buzzer for front and rear door operation.	A. Develop job circuit on chalkboard. 1. Demonstrate different sounds obtained. 2. Demonstrate combination bell-buzzer unit. B. Review mounting of equipment C. Review job wiring procedures D. Test for correct operation from front and rear doors.	Discuss combination bell-buzzer unit. 1. Review bell-buzzer construction. 2. Review bell-buzzer operation. 3. Stress advantages of combination unit.

24. Install a four-wire return call system with door opener in vestibule operated from the kitchen.

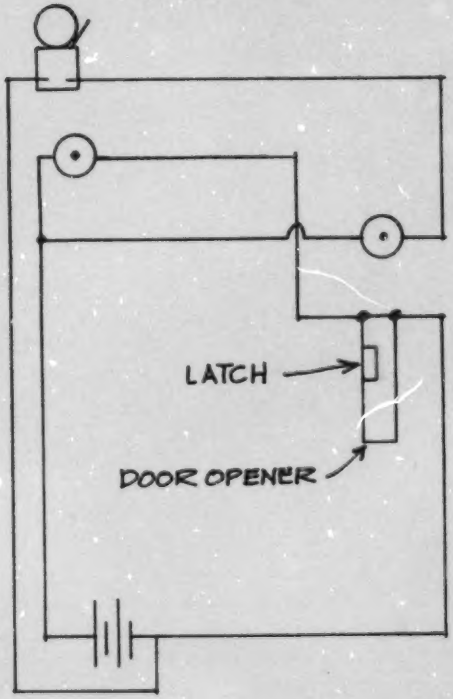


Fig. #6 (4-wire return call)

A. Develop job circuit on chalkboard (See Fig. #6).
   1. Demonstrate connection of door opener into circuit.
   2. Point out how latch on door opener releases.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for job operation.

Discuss door openers.
1. Construction
2. Operation
3. Types

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
25. Install a three-wire return call system in a one-family house with a door opener in the vestibule, operated from the kitchen.	A. Develop job circuit on chalkboard. (See Fig. #7) B. Review operation of door opener. C. Review mounting of equipment and mortising for door opener. D. Emphasize safety procedures when using tools. E. Review job wiring procedures. F. Test for proper operation.	Discuss door frames with regard to door opener installations. 1. Types 2. Materials 3. Moldings
26. Install a three-wire return call system in a two-family house with a door opener in the vestibule, operated from the kitchen.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for correct operation by operating circuits for each floor separately.	Review parallel circuits. 1. Advantages 2. Voltage distribution 3. Operation

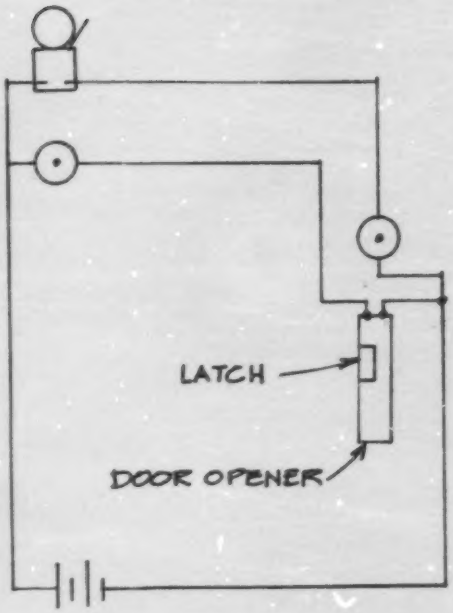
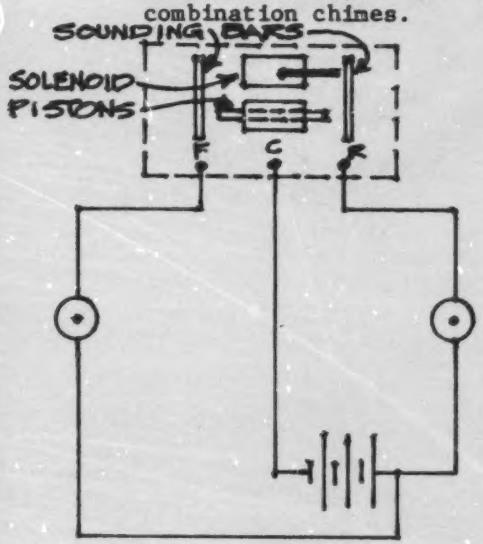


Fig. #7 (three-wire return call)

27. Install a signal system for a two-family house with front and rear entrances, with front door buttons operating bells in kitchens while rear buttons operate buzzers, and buttons in kitchens will operate front and rear door openers.	A. Develop job circuit on chalkboard. B. Review return call systems. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for correct operation by operating each individual circuit.	Discuss wiring methods for multi-level construction. 1. Cutting through floors 2. Fishing 3. Locating hollow spaces
28. Install a signal system for a three-family house, with each front door button operating a bell in each kitchen, and buttons in kitchens operating the door opener.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	Discuss repairing of plaster surfaces. 1. Preparing surface 2. Mixing patching compound 3. Applying compound 4. Finishing surface 5. Protecting furnishings

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
29. Install a signal system with front and rear door buttons operating combination chimes.	A. Develop job circuit on chalkboard. (See Fig. #8) B. Demonstrate sounds obtained from chimes. C. Review mounting of equipment. D. Demonstrate mounting of chimes. E. Review job wiring procedures. F. Test for proper operation. 1. Operate front chime. 2. Operate rear chime.	Discuss combination chimes. 1. Construction 2. Operation 3. Types and variations
30. Install a signal system for a three-family house including apartment door call, whereby front door buttons and apartment door buttons will operate combination chimes, and buttons in kitchens operate the front door opener.	A. Develop job circuit on chalkboard. 1. Review chimes operation. 2. Review door openers. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation by operating each of the nine circuits.	Discuss troubleshooting procedures on signal systems. 1. Testing devices 2. Testing source of supply 3. Testing for opens, shorts, grounds 4. Use of meters



(Fig. #8

Unit II: Double Contact Pushbuttons

Level One: Signal Wiring
Suggested Time: *30 Hours / 45 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install a three-wire return call system using double contact pushbuttons and a bell button.
- Install a special master combination system using D.C.P.B., whereby D.C.P.B.#1 will ring bell #1; D.C.P.B. #2 will ring bells #2 and #3 in parallel; D.C.P.B. #3 will ring bells #1, #2, and #3 in parallel.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
1. Install a three-wire return call using double contact pushbuttons.	A. Develop job circuit on chalkboard. (See Fig. #1.) B. Demonstrate testing for normally open, normally closed contacts on double contact pushbuttons. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for proper operation.	Discuss double contact push buttons. 1. Construction 2. Operation 3. Application 4. Types
2. Install a three-wire master return call system using double contact pushbuttons and a bell button, whereby D.C.P.B. #1 will ring bell #2 and D.C.P.B. #2 will ring bell #1 with master bell button ringing both bells in parallel.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test job for proper operation of each station and master.	Discuss uses for master stations. 1. Common calling 2. Emergency signal

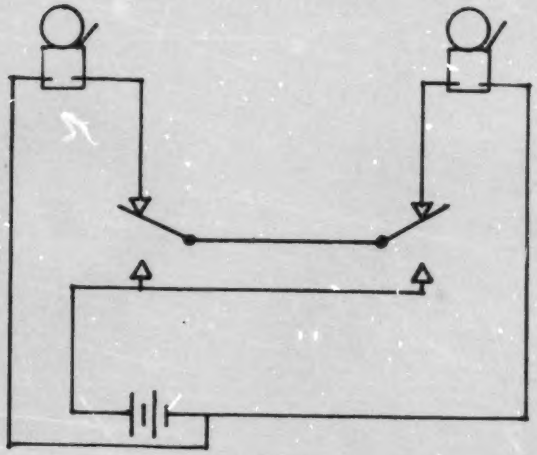


Fig. # 1 - Three-wire return call using normal closed double contact push buttons.

3. Install a two-wire return call system, using D.C.P.B. and two power supplies.	A. Develop job circuit on chalkboard. B. Demonstrate saving a wire by using a second power supply. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for proper operation.	Discuss use of two power sources. 1. Advantage 2. Voltage matching
4. Install a two-station return call system with two D.C.P.B. at each station and two power supplies, in which each station has two points from which signal may be initiated.	A. Develop job circuit on chalkboard. B. Point out that D.C.P.B.'s at each station are parallel with each other. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for proper operation at each of four points.	Discuss method for identifying wires in a cable. 1. Using Ohmmeter 2. Using bell battery tester

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
5. Install a simple master calling system, using D.C.P.B. for each of three stations and a bell button to ring all three stations simultaneously in parallel.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of each station and master.	Discuss series and parallel connections of batteries. 1. Circuitry 2. For higher voltages 3. For higher ampacity
6. Install a multiple-return call system, using D.C.P.B., in which control device at station #1 can ring bells at stations #2, and #3; control device at station #2 can ring bells at stations #1 and 3; control device at station #3 can ring bells at stations #1 and 2.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of each station.	Discuss troubleshooting procedures in D.C.P.B wiring. 1. Test for opens. 2. Test for shorts. 3. Test for poor contacts.

7. Install a special master combination system using D.C.P.B., in which D.C.P.B. #1 will ring bell #1; D.C.P.B. #2 will ring bells #2 and #3 in parallel; D.C.P.C. #3 will ring bells #1, #2, #3 in parallel.

A. Develop job circuit on chalkboard.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation at each station and master.

Discuss transformer principles.
1. Cores - material and shapes.
2. Ratio of turns to voltage.
3. Cooling methods.

8. Install a signal system with dual control using D.C.P.B. and a master button, whereby each of bells "A" "B" and "C" can be controlled from two locations, and the pushbutton will ring all bells simultaneously.

A. Develop job circuit on chalkboard.
B. Point out that individual ringing is through N.O. contacts as in pushbuttons.
C. Point out that master button connects to N.C. contacts for all D.C.P.B.
D. Review mounting of equipment.
E. Review job wiring procedures.
F. Test for proper operation at each station and master.

Discuss principles of electrical generation
1. Magnetic flux
2. Conductors
3. Movement
4. Variation of voltage

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
9. Install a small school signal system using D.C.P.B., in which devices #1,2,3, can ring bells #1,2,3, respectively and submaster device "A" will ring bells #1, #2, and 3 in parallel simultaneously; devices #4,5, and 6 can ring bells #4, 5, and 6 respectively and sub-master device "B" will ring bells #4,5,6 (in parallel) simultaneously; master device "M" will ring all bells (in parallel) simultaneously.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedure. D. Test for correct operation of individually ringing circuits, submasters, and job-masters.	Discuss multi-range meters 1. Reason for multi-ranges 2. Reading various ranges 3. Working out various range readings

Unit III: Annunciator Circuits

Level One: Signal Wiring
Suggested Time: *30 Hours / 45 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install a gravity drop annunciator system from a separate location for each drop.
- Install a four-station annunciator call system providing parallel annunciators in a main office and a warehouse.
- Install an electric reset annunciator call system with a remote reset control.

3. Install a return call annunciator system, using pushbuttons, in which each station has a bell and button to initiate and receive return call.	A. Demonstrate job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of initial call and return.	A. Discuss: 1. Uses for a return call system. 2. Various identifying labels used on annunciator drops. 3. Circuit analysis and design. B. Discuss job opportunities in electrical trades. 1. Construction 2. Maintenance 3. Manufacturing 4. Sales 5. Design 6. Related fields
4. Install a return call annunciator system using double contact push buttons with normally open and normally closed contacts.	A. Develop job circuit on chalkboard. 1. Show how D.C.P.B. save wire compared to use of pushbuttons. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of each station.	Discuss cost comparison of jobs #3 and #4. 1. Equipment cost 2. Conductor cost 3. Labor costs

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
5. Install two annunciators at separate locations to be connected in series.	A. Develop job circuit on chalkboard. 1. Point out reason for series connection (Fail Safe: one cannot work without the other) B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. E. Check for series connection by opening circuit at some point.	Review series circuits 1. Characteristics 2. Voltage distribution 3. Current flow
6. Install a four-station annunciator call system, providing parallel annunciators in a main office and a warehouse.	A. Develop job circuit on chalkboard. 1. Point out advantage of parallel connection. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of each station.	Review parallel circuits 1. Characteristics 2. Voltage distribution 3. Current flow

7. Install a gravity drop annunciator system to be operated by D.C.P.B. and a P.B. master.	A. Develop job circuit on chalkboard. 1. Point out function of N.C. contact for mastering. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of individual circuits and master circuit.	Discuss calculation of power used in a circuit 1. Meaning of power 2. Formula: P = E x I 3. Calculations using formula
8. Install four drop annunciators on the second and third floors of a small motel. Add a two-drop annunciator at main desk to indicate which annunciator is being operated. Individual room buttons will operate annunciators on the floors.	A. Develop job circuit on chalkboard. 1. Point out why drops at main desk must be in series with the respective floors. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from each point of call and at annunciators.	Discuss troubleshooting procedures on annunciator systems. 1. Testing equipment 2. Point to point testing 3. Shorts and grounds.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
9. Install an elevator annunciator call system with an emergency alarm bell to be operated from the elevator car.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. 1. Preparing elevator cable. 2. Installing elevator cable. D. Test for proper operation.	Discuss elevator cable wiring 1. Conductors 2. Supports 3. Code Regulations
10. Install a constant ringing drop annunciator with alarm bell to be operated from four locations.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of constant ringing drop. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation of annunciator and C.R.D.	Discuss constant ring annunciators 1. Construction 2. Operation 3. Purpose

11. Install an electric reset annunciator call system with a remote reset control.

A. Develop job circuit on chalkboard.
   1. Point out added feature of electric reset annunciator.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation of annunciator and reset.

Discuss electric reset annunciator.
1. Construction
2. Operation
3. Advantages

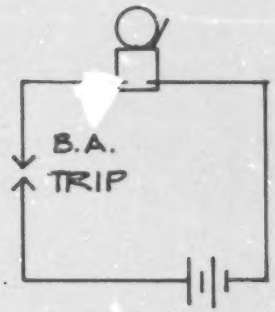
Unit IV: Open Circuit Burglar Alarms

Level One: Signal Wiring
Suggested Time: *40 Hours / 60 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install a simple open circuit burglar alarm using a door trip and a bell.
- Install an open circuit burglar alarm to protect a door and window with a Yale lock switch to permit entry without sounding the alarm.
- Install a four-entry open circuit burglar alarm system with a B.A. annunciator and Yale lock switches at the two door entry points to permit entry without sounding alarm.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
1. Install a simple open circuit burglar alarm using a door spring and a bell.  Fig. #1	A. Develop job circuit on chalkboard. (Fig. #1) B. Demonstrate installation of door spring 1. Drilling and mortising of door jamb C. Review job wiring procedures. D. Test for proper operation.	Discuss alarm springs 1. Construction 2. Operation 3. Applications (window transom, door) 4. Testing
2. Install a simple open circuit burglar alarm using a door trip and a bell.	A. Develop job circuit on chalkboard. B. Demonstrate mounting of door trip. C. Review job wiring procedures. D. Test for proper operation.	Discuss door trips 1. Construction 2. Operation 3. Application 4. Testing

3. Install an open circuit burglar alarm system to protect front and rear entrances of a store.

A. Develop job circuit on chalkboard.
   1. Point out that trips must be connected in parallel.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test job for proper operation at front and rear entrances.

4. Install an open circuit single entry burglar alarm system with a constant ringing drop. C.R.D. is to be independently connected.

A. Develop job circuit on chalkboard. (See Fig. #2)
B. Demonstrate operation of C.R.D.
C. Review mounting of equipment.
D. Review job wiring procedures.
E. Test for proper operation
   1. Ringing is maintained until C.R.D. is reset.

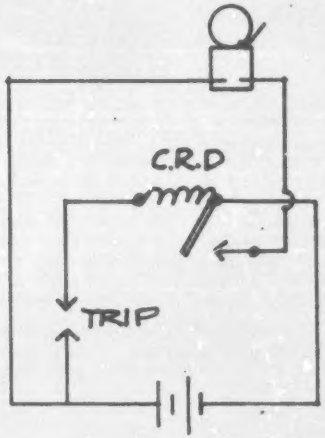


Fig. #2

A. Discuss disadvantages of jobs #1, 2, and 3 as a security system
   1. Alarm is silenced as soon as door is closed.
B. Introduce constant ringing drop as means of overcoming disadvantage cited.

Discuss constant ringing drop.
   1. Construction
   2. Operation
   3. Function

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
5. Install an open-circuit single-entry burglar alarm system with a constant ringing drop. Connect a C.R.D. coil in parallel with alarm bell.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Discuss code regulations for burglar alarm wiring (Article 800, N.E.C.)
6. Install an open-circuit, single-entry burglar alarm system with a constant ringing drop. Connect a C.R.D. coil in series with the alarm bell.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Compare the C.R.D. connections (independent, parallel, series.) Discuss advantages and disadvantages of each type of connection.

7. Install an open-circuit burglar alarm system to protect two doors and one window in a store. Use a C.R.D. for constant ringing, a battery as a power source, and a line switch to disconnect power supply.	A. Develop job circuit on chalkboard. B. Demonstrate installation of trips on windows. C. Review job wiring procedures. D. Test job for proper operation from each entry.	Discuss use of battery as a power source. 1. Advantage (in cases of power failure) 2. Disadvantage (maintenance and replacement)
8. Install an open-circuit burglar alarm to protect a door and a window with a Yale lock switch to permit door entry without sounding the alarm.	A. Develop job circuit on chalkboard. B. Demonstrate operation of Yale lock switch. C. Demonstrate installation of Yale lock switch. D. Review job wiring procedures. E. Test job for proper operation with lock switch in on and off positions.	Discuss Yale lock switches. 1. Reasons for use 2. Construction 3. Operation 4. Installation procedure 5. Wiring procedure

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
9. Install an open-circuit burglar alarm system to protect two doors with Yale lock switches at both entries. Alarm may be energized or de-energized from either entry.	A. Develop job circuit on chalkboard. B. Demonstrate use of travelers for interconnection of lock switches. C. Review mounting of equipment. D. Review job wiring procedure. E. Test job for proper operation from both entries.	Compare lock switches with two point lever switches. Show why single-pole switches cannot be used in this job. Compare number terminals. Compare possible circuitry.
10. Install a four-entry, open-circuit system with an annunciator to indicate point of entry.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedure. D. Test job for proper operation. E. Check for indication of point of entry on annunciator.	Review annunciators 1. Construction 2. Operation 3. Application 4. Purpose

11. Install a two-entry combination and call bell system using double contact push-buttons and a door spring at each point of entry.

A. Develop job circuit on chalkboard.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test job for proper operation at call stations and trip points.

Review double contact pushbuttons
1. Each D.C.P.B. rings its respective bell.
2. Closing either door spring will energize the C.R.D. and both bells.

12. Install an open-circuit, burglar alarm system to protect a store at one entrance with constant ringing. Include a two-point lever switch for supervisory testing.

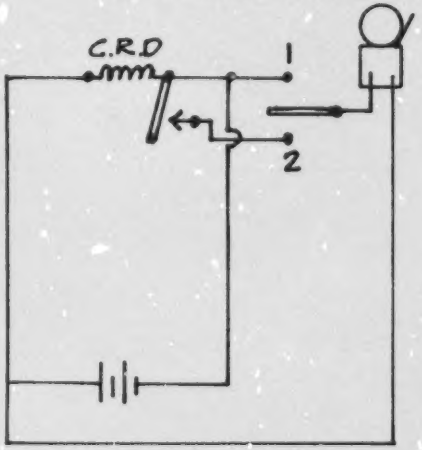


Fig. #3

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A. Develop job circuit on chalkboard. (See Fig. #3)
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation of alarm system and supervisory feature.
    1. Make bell test.
    2. Make silent test.

A. Discuss procedure for and purpose of supervisory tests. (See Fig. #1.)
    1. Lever switch on position #1 to test bell and bypass control circuit.
    2. Lever switch in center to permit testing of control circuit without sounding bell.
    3. Lever switch in position #2, normal operating position.

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Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
13. Install a four-entry burglar alarm using a special annunciator which provides for constant ringing.	A. Develop job circuit on chalkboard. B. Demonstrate operation of constant ringing annunciator. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for proper operation.	Discuss constant ringing burglar alarm annunciator. 1. Construction 2. Operation 3. Use 4. Advantage
14. Install a four-entry burglar alarm, using a special burglar alarm annunciator which provides for constant ringing. Add two two-point lever switches to permit supervisory testing.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	Discuss testing procedure. 1. Bell test: Close switch A2 and B3. 2. Silent test: Close switches A2 and B4. 3. Operative test: Close switches A1 and B3.

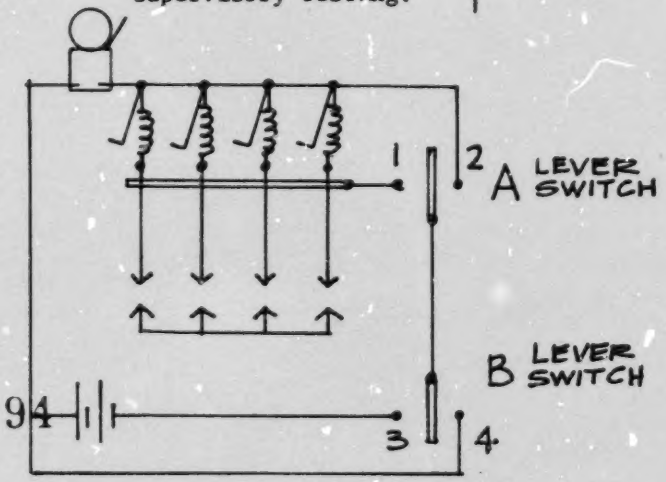

Fig. #4

15. Install a four-entry, open-circuit burglar alarm system with a B.A. annunciator and Yale lock switches at the two door entry points to permit entry without sounding alarm.

A. Develop job circuit on chalkboard.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation.

A. Review open-circuit burglar alarms.
    1. Equipment
    2. Circuitry
    3. Advantages
    4. Disadvantages

Unit V: Closed Circuit Burglar Alarms

Level One: Signal Wiring
Suggested Time: *50 Hours / 75 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install a single-entrance closed circuit burglar alarm system using closed circuit relay.
- Install a closed circuit burglar alarm system consisting of two window springs and a door spring. Use a Yale lock switch and a two-point lever switch to bypass the door spring.
- Install wiring and test an auto-burglar alarm system.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
1. Install a single-entrance, closed-circuit burglar alarm system, using a closed-circuit relay.	A. Develop job circuit on chalkboard. (See Fig. # 1.) B. Demonstrate operation of relay. C. Identify protective and alarm circuits. D. Review mounting of equipment. E. Review job wiring procedures. F. Test for proper operation.	A. Discuss closed circuit burglar alarm systems. 1. Characteristics 2. Compare to open circuit 3. Applications B. Discuss advantages of using separate batteries for the protective circuit and the alarm circuit. 1. Point out that job can be done with one battery.

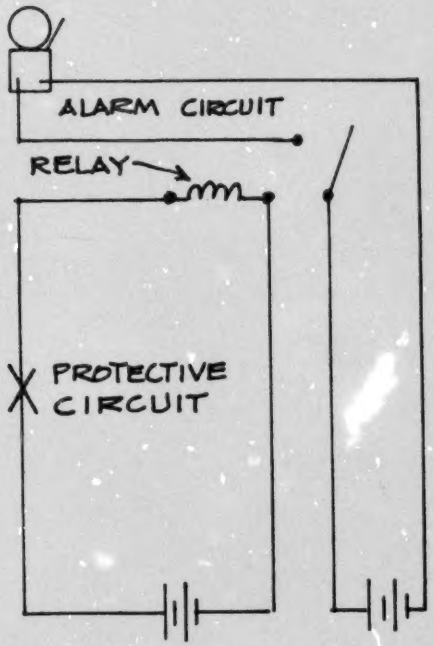

Fig. #1

2. Install a closed-circuit burglar alarm system, protecting three points of entrance in a store.	A. Develop job circuit on chalkboard. B. Point out series connection of springs. C. Review mounting of equipment. D. Review job wiring procedures. E. Test for proper operation 1. Demonstrate that break at any point activates alarm.	A. Discuss closed circuit burglar alarm relay 1. Construction 2. Operation 3. Circuitry
3. Install a closed-circuit burglar alarm system, protecting three points of entrance: two window springs and one door spring with dual lock switch control.	A. Develop job circuit on chalkboard. B. Demonstrate how closing lock switch shunts out door spring. C. Review mounting of equipment. 1. Review how to cut in and mortise for a door spring. D. Review job wiring procedures. E. Test for proper operation. 1. Operate circuit from springs. 2. Close lock switch,and note effect on circuit.	A. Review battery connections 1. Series for voltage increase 2. Parallel for greater ampacity 3. Series - parallel for combination of greater voltage and ampacity
101		102

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
4. Install a closed-circuit burglar alarm system protecting three points of entrance with a constant ringing drop.	A. Develop job circuit on chalkboard. (See Fig. #2) 1. Demonstrate operation of constant ringing drop. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. 1. Point out constant ringing feature through use of constant ringing drop.	A. Review constant ringing drop. 1. Construction 2. Operation 3. Circuitry

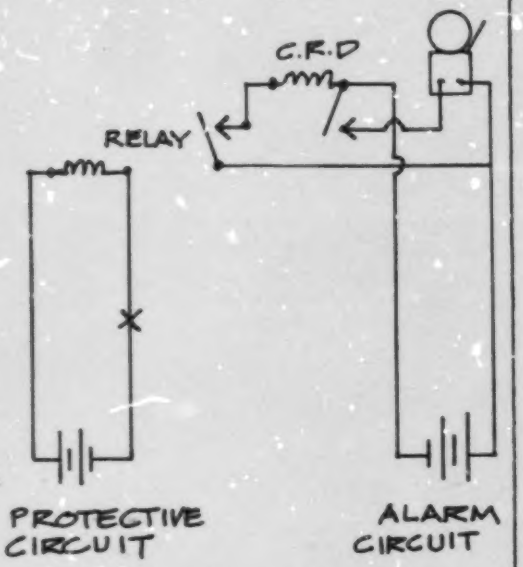

Fig. #2

5. Install a combination closed-circuit and open-circuit system to protect two points of entry.

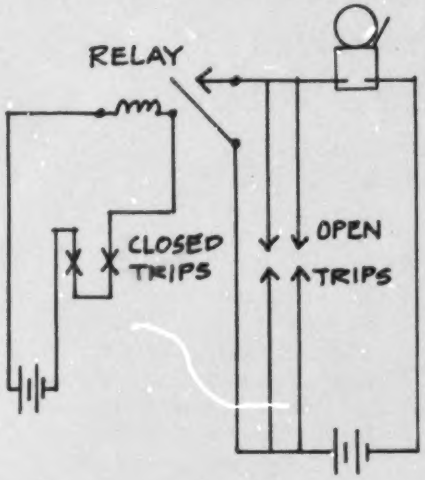

Fig. #3

A. Develop job circuit on chalkboard. (Fig. #3)
   1. Point out dual system operation.
B. Review mounting of equipment.
C. Review job wiring procedures.
D. Test for proper operation.
   1. Open circuit section
   2. Closed circuit section

A. Discuss advantages of system used on this job:
   Added protection feature, making burglars unaware that a double system is installed.
B. Review series circuitry for closed-circuit section.
C. Review parallel circuitry for open circuit section.

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
6. Install a closed-circuit burglar alarm system, consisting of two window springs and a door spring. Use a Yale lock switch and a two-point lever switch to bypass the door spring. Use a one-point lever switch to cut out window springs and a two-point lever switch to permit supervisory testing.	A. Develop job circuit on chalkboard. 1. Discuss use of switches in circuit. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. 1. Operate normally. 2. Bypass window springs. 3. Bypass door. 4. Make supervisory tests.	A. Discuss supervisory tests. 1. Purpose 2. Method (See Fig. #4) a. Lever switch (A) in position #1 tests the bell only. b. Lever switch (A) in position #2 tests entire system and is the normal operating position. c. Lever switch (A) in center tests protective circuit only.

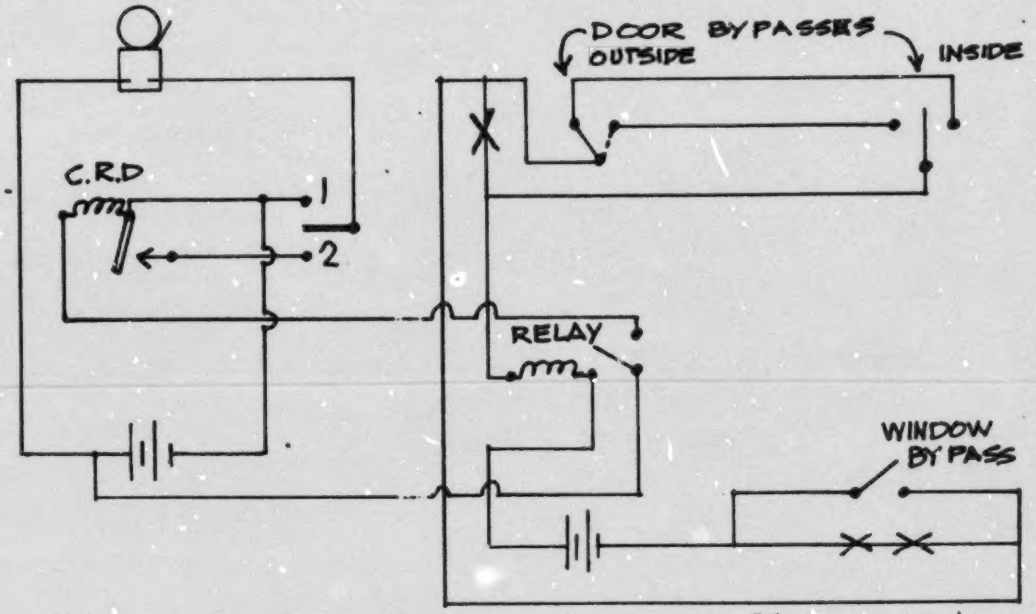

Fig. #4

7. Install a closed-circuit burglar alarm system protecting three glass areas in a store with tinfoil metallic ribbon.

A. Develop job circuit on chalkboard.
B. Demonstration installation of tin foil ribbon.
C. Review job wiring procedures.
D. Test for proper operation.

A. Discuss tinfoil installations.
   1. Decorative designs
   2. Preparing the glass
   3. Types of ribbon
   4. Protection of the ribbon
   5. Connection to circuit conductors

TEACHING CONTENT		
Tasks	Development of Skills	Development of Related Information
8. Install a combination open and closed-circuit burglar alarm system in a dwelling protecting four points of entry with a C.R.D. and an annunciator to indicate point of entry. (Fig. #5)	A. Develop job circuit on chalkboard (See Fig. #5) 1. Demonstrate operation of annunciator. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation. 1. Closed circuit section 2. Open circuit section, including annunciator	A. Review annunciators 1. Purpose 2, Construction 3. Operation 4. Circuitry

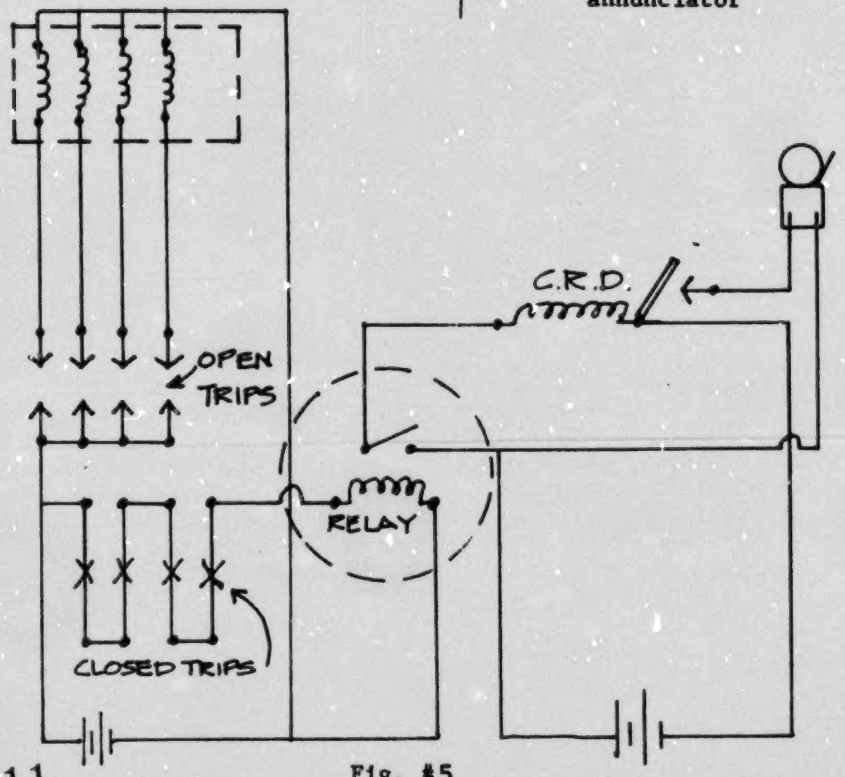

Fig. #5

9. Install a three-drop annunciator system for door call in a triple entrance building. Add a closed-circuit burglar alarm system for night protection with a switch to provide day-night operation. Include two two-point lever switches to permit supervisory testing.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation 1. Day operation 2. Night operation 3. Supervisory testing	A. Discuss methods of wiring burglar alarm circuits. 1. Type of conductors 2. Cable runs 3. Methods of securing 4. Code requirements
10. Install a closed-circuit home burglar alarm system for protecting three points of entry with tinfoil ribbon for the windows and a door spring for the door. Include a constant ringing drop.	A. Develop job circuit on chalkboard. B. Review installation of tinfoil. C. Review job wiring procedures. D. Test for proper operation at each entrance and for constant ringing.	A. Discuss troubleshooting procedures on burglar alarm systems. 1. Checking equipment. 2. Locating faults. 3. Using testers.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
11. Install burglar alarm components on an auto chassis.	Demonstrate. 1. Drilling holes for door springs and key lock switch 2. Use of Greenlee cutter 3. Mounting brackets for trunk and hood springs 4. Mounting equipment with self-tapping screws	A. Discuss components used for this installation. 1. Springs 2. Key lock 3. Locking relay 4. Blaster or horn Safety: Be aware of sharp edges left by Greenlee cutter

12. Install wiring and test an auto-burglar alarm system. (See Fig. #6)

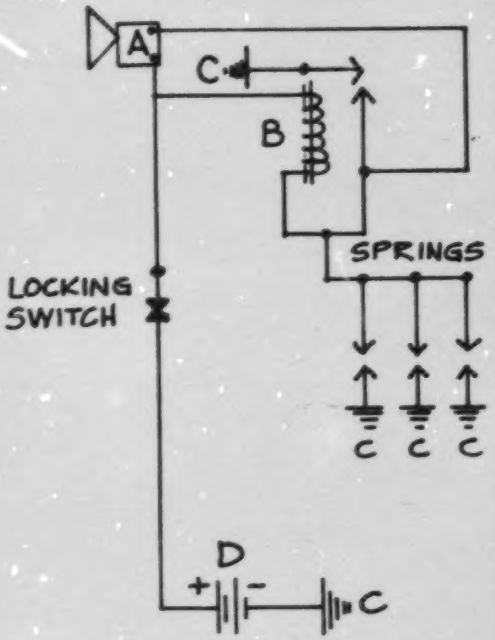

Fig. #6

A = BLASTER
B = LOCKING RELAY
C = GROUND TERMINAL
D = BATTERY

A. Develop job circuit on chalkboard. (See Fig. #6)
   1. Point out use of frame as return wire.
B. Demonstrate wiring of components.
C. Test for proper operation.

A. Discuss operation of auto-burglar alarms.
   1. Types
   2. Circuitry
   3. Troubleshooting
   4. Repairing defects

Safety: Disconnect battery ground (-) cable.
Install ground (-) cable last when connecting circuit.

Unit VI: Fire Alarms

Level One: Signal Wiring
Suggested Time: *40 Hours / 60 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install a four-station open circuit fire alarm system, using manual break glass call boxes, with an annunicator at a central location to indicate where alarm originated.
- Install a three-station open circuit fire alarm system with manual and an automatic fire detector at each station.
- Install a three-station closed circuit, supervised fire alarm system, using a standard control panel. Install a C.C.F.A. box and single-stroke gong at each station.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
1. Install a four-station, open-circuit fire alarm system, using manual break-glass call boxes with an annunciator at a central location to indicate where alarm originated.	A. Develop job circuit on chalkboard. 1. Demonstrate operation of equipment in circuit. B. Demonstrate mounting of fire alarm equipment. C. Review job wiring procedures. D. Test for proper operation from each station and at central location.	A. Discuss basic fire alarm information. 1. Purpose 2. Installation requirements 3. Type systems 4. Coding regulations

2. Install a three-station, open-circuit fire alarm system using selective ringing box and a gong at each station.

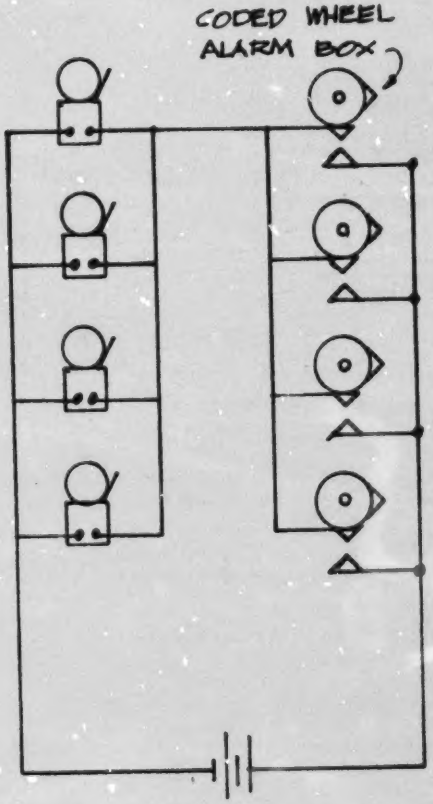

Fig. #1

A. Develop job circuit on chalkboard (See Fig. #1.)
   1. Demonstrate operation of selective ringing box.
B. Review mounting of fire alarm equipment.
C. Review job wiring procedures.
D. Test for proper operation from each box.

A. Discuss slective ringing boxes.
   1. Purpose
   2. Construction
   3. Circuitry

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
3. Install a two station, closed circuit fire alarm system with a break-glass fire alarm box and a vibrating gong at each station. The gongs operate on a separate set of batteries through a relay.	A. Develop job circuit on chalkboard (See Fig. #2) 1. Point out closed-circuit wiring and open-circuit wiring. 2. Point out use of two batteries. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Discuss and compare types of fire alarm systems. 1. Open-circuit 2. Coded open-circuit 3. Coded closed-circuit

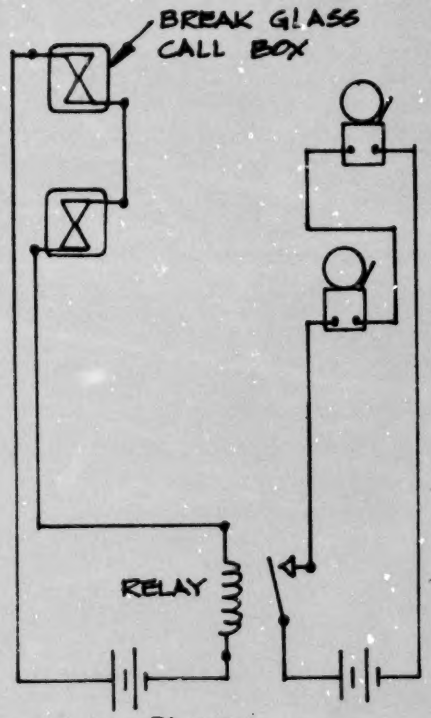

Fig. #2

4. Install a one-station, closed-circuit, coded-ring fire alarm system. Use a coded box and single-stroke gong which operates from a separate battery through a relay.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation	A. Discuss single-stroke gong. 1. Construction 2. Operation B. Review coded ringing boxes.
5. Install and connect a two-station, coded-series, closed-circuit fire alarm system with a trouble bell. Connect the C.C.F.A. boxes and single-stroke gongs in series. The trouble bell rings through contact of the relay using a separate source of power.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test job for proper operation.	A. Discuss requirements for fire alarm installations. 1. Must be in rigid conduit 2. No splices 3. No fuses 4. Minimum heights of panels, gongs, boxes. B. Explain purpose of trouble bell.

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
6. Install and connect a pre-signal F.A. system for a two-story building. Install a station box and a general alarm gong on each floor. Install a trouble bell in central location and pre-signal gongs in two central locations.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test job for proper operation.	A. Discuss basic fire alarm information. 1. Maximum number of gongs on a D.C. circuit and on an A.C. circuit. 2. Maximum current flow for gong and box circuits. 3. Required resistance value for gongs. 4. Signal box timing. B. Explain "pre-signal": notice to a control station, which in turn initiates an actual fire alarm.
7. Install and connect a closed circuit selective ringing box and an open-circuit selective ringing box to operate two simple stroke fire alarm gongs.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test job for proper operation.	A. Compare construction of vibrating bells and single-stroke gongs. Introduce the solenoid. B. Explain advantages of open and closed-circuit boxes.

8. Install an open-circuit fire alarm system for a three-story factory. Install one gong and one non-coded F.A. station on each floor with an annunciator at a central location to register origin of alarm.	A. Develop job circuit on chalkboard. 1. Review purpose and operation of annunciator. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from each station and at central annunciator.	A. Discuss National Electric Code regulations for fire alarm systems (Article 760.) 1. General regulations 2. Nonpower-limited circuits 3. Power-limited circuits
9. Install a three station, open circuit fire alarm system with selective ringing at all stations and constant ringing at central control. Use an annunciator to indicate origin of alarm.	A. Develop job circuit on chalkboard. 1. Explain operation of continuous ringing annunciator. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation.	A. Review the constant ringing annunciator. 1. Construction 2. Circuitry 3. Ringing feature

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
10. Install a three-station open-circuit fire alarm system with a manual alarm and an automatic fire detector at each station.	A. Develop job circuit on chalkboard. B. Demonstrate installation of automatic fire detectors. C. Review job wiring procedures. D. Test for proper operation. 1. Activate manual alarms 2. Cause automatic fire detectors to operate by application of heat.	A. Discuss open-circuit type automatic fire detectors. 1. Principle of operation 2. Purpose 3. Circuitry 4. Location in installation
11. Install a three-station, closed-circuit fire alarm system with a manual alarm and an automatic fire detector at each station.	A. Develop job circuit on chalkboard. B. Demonstrate installation of automatic fire detectors. C. Review job wiring procedures. D. Test for proper operation. 1. Activate manual alarms. 2. Cause automatic fire detectors to operate by application of heat.	A. Discuss closed-circuit automatic fire detectors. 1. Principle of operation 2. Purpose 3. Circuitry 4. Location in installation

12. Install a three-station, closed circuit, supervised fire alarm system, using a standard control panel. Install a C.C.F.A. box and single-stroke gong at each station.

A. Develop job circuit on chalkboard.
B. Demonstrate mounting of control panel.
C. Review job wiring procedures.
D. Test for proper operation.

A. Discuss fire alarm control panel
   1. Parts - relays, resistors, time delay cutout, milliammeter
   2. Principle of operation of parts
   3. Tests on fire alarm systems
   4. Troubleshooting on fire alarm systems

Unit VII: Telephones

Level One: Signal Wiring
Suggested Time: *30 Hours / 45 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Install and connect a two-station, three-wire telephone system using pushbuttons for ringing circuit.
- Install and connect a three-station and vestibule station telephone system. The vestibule phone has a press-to-talk button which completes the talking circuit.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
1. Prepare, test, and identify a telephone cable, and connect to terminal blocks.	A. Demonstrate 1. Cutting cable 2. Stripping outer cover 3. Forming wires to terminal blocks 4. Lacing conductors 5. Skinning ends of conductors 6. Connecting conductors to terminals on blocks 7. Continuity testing procedures	A. Discuss 1. Telephone cables - types, colors, sizes 2. Color coding - reasons 3. Reasons for lacing and types of ties
2. Install and connect a two-station, three-wire telephone system using pushbuttons for the ringing circuit.	A. Develop job circuit on chalkboard. (See Fig. #1.) B. Demonstrate mounting of equipment. C. Demonstrate job wiring procedures. D. Test for proper operation of ringing and talking circuits	A. Discuss 1. Telephone receiver 2. Operation 3. Construction 4. Circuitry 5. Transmitter operation 6. Hook-up operation

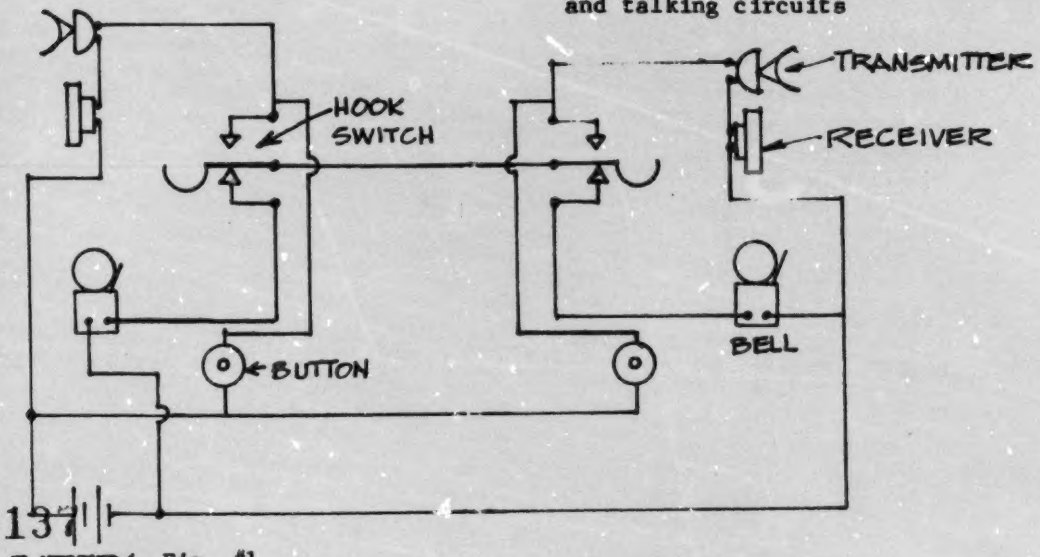

Fig. #1

3. Install a two-station, two-wire telephone system, using pushbuttons for ringing.	A. Develop job circuit on chalkboard. B. Demonstrate mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from either station.	A. Discuss transmitters. 1. Construction 2. Principle of operation 3. Circuitry
4. Install a two-station, three-wire telephone system, using double contact pushbuttons for ringing and local batteries.	A. Develop job circuit on chalkboard 1. Review operation of D.C.P.B. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from both stations.	A. Discuss telephone hand-phone. 1. Construction 2. Principles of operation 3. Circuitry

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
5. Install a two-station, three-wire telephone system, using double contact pushbuttons for ringing and power source at one station only.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from both stations.	A. Discuss telephone hook switch. 1. Purpose 2. Parts 3. Principle of operation 4. Circuitry
6. Install and connect a three-station and vestibule station telephone system. The vestibule phone has a press-to-talk button, which completes the talking circuit.	A. Develop job circuit on chalkboard B. Review mounting of equipment C. Review job wiring procedures D. Test for proper operation from each of the three stations.	A. Discuss National Electric Code requirements for telephone systems (Article 800).

7. Install and connect a three-station, common talking, common ringing, intercommunicating phone system. Use pushbuttons for ringing. Use four-wire cable.	1. Develop job circuit on chalkboard. 2. Review mounting of equipment. 3. Review job wiring procedures. 4. Test for proper operation from all three stations.	A. Discuss troubleshooting telephone systems. 1. Testing equipment 2. Continuity testing 3. Common problems
8. Install and connect a three station, common talking, selective ringing, intercommunicating phone system. Use pushbuttons for ringing. Use six-wire cable. Use bell ringing transformer and battery for power sources.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from all three stations.	A. Review battery connections. 1. Series for increased voltage 2. Parallel for increased voltage 3. Series - parallel for combination of increased voltage and ampacity

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
9. Install and connect a two-station - two-wire phone system with local battery and induction coil at each station. Use double contact push buttons (N.C.) for ringing.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from either station.	A. Discuss the induction coil 1. Construction 2. Principle of operation 3. Purpose 4. Testing procedures 5. Work out examples of primary - secondary ratios.
10. Install and connect a four-station and a vestibule station apartment house telephone system. The apartment phones have a door opener button and press-to-talk button.	A. Develop job circuit on chalkboard. B. Review mounting of equipment. C. Review job wiring procedures. D. Test for proper operation from all stations.	A. Review telephones. 1. Components 2. Circuits 3. Cable work 4. Troubleshooting

Unit VIII: Basic Electronics — Solid State

Level One: Signal Wiring
Suggested Time: *60 Hours / 90 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

. Identify symbols used in electronic circuits.
. Identify resistor values using a volt-ohmeter.
. Wire a power transformer circuit.
. Locate faults and make repairs on electronic circuits.

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
1. Lay out and drill a chassis for a light actuated alarm kit. (See Column three, item B.)	A. Demonstrate. 1. How to make copy of layout 2. How to locate, mark, and center punch holes for drilling. 3. How to drill holes on drill press. 4. How to remove burrs with a file. 5. How to polish chassis with emery cloth. B. Assign students to perform above steps on their chassis for grading.	A. Discuss electronics industry, in general. 1. Meaning of electronics 2. Industrial applications 3. Comparing vacuum tubes to solid-state devices. B. Alarm kit: Kelvin Electronics, Stock # 151-20 C. Stress safety factors.
2. Identify symbols used in electronic circuits.	A. Display. 1. Various types of switches 2. Resistors and potentiometers 3. Various vacuum tubes 4. Various solid-state devices B. Have students identify samples of above components on work sheet. C. Have students submit work sheet for grade.	A. Discuss the components used in the job 1. Construction 2. Purpose 3. Principle of operation 4. Ratings 5. Applications

3. Identify resistor values, using resistor color code.	A. Display several resistors 1. Point out color bands 2. Explain specific value of each band B. Display resistor color code chart 1. Demonstrate layout of chart and discuss information on it. 2. Using chart, calculate value of resistors displayed. 3. Have students work out value of several resistors. C. Assign each student a group of resistors. Have individual record resistor values on work sheet.	A. Discuss resistors 1. Types 2. Construction 3. Values 4. Applications 5. Tolerance factor 6. Ratings
4. Identify transistor bases and chassis wiring color code.	A. Display pre-wired electronic chassis and several transistor bases. 1. Point out need for uniform procedure in wiring methods. 2. Discuss function of different colored wires on chassis (example: gray A.C. power lines.) B. Assign transistors and chassis bases to students. 1. Have them identify leads and pins for recording on work sheets. 2. Have students submit work sheets for grading.	A. Discuss transistors 1. Construction 2. Types 3. Principle of operation 4. Advantages compared to vacuum tubes 5. Applications

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
5. Identify resistor values using a volt-ohmmeter.	A. Display several resistors and volt-ohmmeter 1. Demonstrate actual resistor values, using ohmmeter. 2. Demonstrate use of volt-ohmmeter 3. Measure value of several resistors. 4. Select individuals to repeat demonstration. B. Assign to each student the same group of resistors used on task #3. 1. Have them measure and record values on work sheet used on task #3. 2. Have students compare measured value and color code value of each resitor. 3. Have students submit their work for grading.	A. Discuss volt-ohmmeter 1. Basic construction 2. Applications 3. Ranges 4. How to read meter 5. Precautions
6. Identify vacuum tube elements, using a tube manual.	A. Display several types of tubes. 1. Demonstrate briefly the use of each tube. 2. Demonstrate how to identify tubes by use of the tube manual. 3. Select several students to repeat tube identification. B. Assign several tube numbers to each student. 1. Have them locate these tubes in the tube manual. 2. Have students make a drawing of each tube on their work sheets. 3. Have students submit their work for grading.	A. Discuss vacuum tubes 1. Construction 2. Principle of operation 3. Types 4. How to identify pins 5. Comparison to solid-state devices.

7. Inventory and test components for alarm kit.

A. Display components package to be used on alarm kit.
   1. Discuss reasons for inventorying components.
   2. Discuss importance of pretesting components
B. Demonstrate how to inventory components
C. Demonstrate how to pretest
   1. Resistors
   2. Transformer
   3. Line Cord
   4. Switch
   5. Diode
   6. SCR
   7. Capacitor
D. Distribute work sheets
   1. Have students inventory components using check list.
   2. Have students pretest components and record results.
   3. Have students submit their work for grading.

A. Discuss inventorying
   1. Meaning
   2. Purpose - give examples
   3. Importance for job being done.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
8. Mount alarm kit components on prepared chassis (from task #1)	A. Display chassis to be used for alarm kit. 1. Discuss importance of mounting components correctly. 2. Demonstrate how each component is to be mounted. 3. Demonstrate mounting of components using basic hand tools. B. Assign students to mount components on their chassis using pictorial design provided in kit as a guide. C. Have students submit their work for a grade.	A. Review series circuits. 1. Relate to electronics circuitry 2. Voltage values 3. Current values 4. Resistance values 5. OHMS Law in series circuits for total values and part values.
9. Test capacitors, using a capacitor tester.	A. Display several capacitors. 1. Describe briefly use in the kit being made. 2. Discuss meaning of ratings. 3. Explain purpose of color bands. B. Display capacitor testor. 1. Describe its purpose. 2. Demonstrate how to check several capacitors. 3. Have students repeat demonstration. C. Assign group of capacitors to each student for testing. 1. Have them record results on work sheet. 2. Have them submit work for grading.	A. Discuss capacitors. 1. Use in electronic circuits 2. Construction 3. Types 4. Principle of operation 5. Ratings

10. Wire a power transformer circuit.	A. Display power transformer and discuss its function in the alarm circuit. B. Demonstrate how to make connections for transformer. C. Demonstrate how to check primary and secondary voltage with volt-ohmmeter D. Assign students to three activities. 1. Wire transformer. 2. Check input and output voltages. 3. Record for grade.	A. Review transformers. 1. Purpose 2. Types 3. Applications 4. Voltage ratio 5. Voltages used in job being wired
11. Connect and test the rectifier-filter circuit on the alarm kit.	A. Develop A.C. sine wave on chalkboard, and point out why it cannot be used in this circuit. B. Explain characteristics of a diode, and illustrate how a diode functions as a half-wave rectifier. C. Point out need to smooth out half-wave output. D. Explain characteristics of a capacitor, and illustrate its connection and function in the circuit. E. Demonstrate how to wire rectifier-filter circuit. F. Demonstrate how to test rectifier-filter circuit using oscilloscope. G. Assign students to wire rectifier-filter circuit on their chassis. H. Assign students to test rectifier-circuit on oscilloscope; record results on work sheets and submit for grade.	A. Discuss half-wave rectification. 1. Meaning and purpose 2. Advantage and disadvantage 3. How obtained with vacuum tubes and solid state devices

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
12. Connect and test the sensitivity and photo cell circuit on the alarm kit.	A. Display resistor, potentiometer and photo cell to be wired. 1. Describe their function in the alarm kit. B. Demonstrate how to connect components into circuit. C. Demonstrate testing of sensitivity control and photo cell. 1. Place volt-ohmmeter across photo cell. 2. Vary sensitivity control to show changing voltage. D. Assign students to perform wiring on their alarm kits, test with volt-ohmmeter, and submit results for grade.	A. Discuss potentiometer 1. Construction 2. Principle of operation 3. Purpose B. Discuss photo-cells 1. Construction 2. Principle of operation 3. Applications
13. Connect and test the alarm-activating circuit.	A. Display the silicon controlled rectifiers - 1. Describe their function in the alarm kit. B. Demonstrate connecting of SCR and momentary contact switch into circuit. C. Connect an external light source to output terminals and test entire alarm circuit. D. Assign students to complete wiring the alarm kit and to test entire circuit.	A. Discuss silicon controlled rectifiers (SCR.) 1. Definition 2. Construction 3. Principle of operation 4. Applications 5. Comparison to vacuum tube devices

14. Lay out and drill chassis for speed control kit* (See column three, item B.)	A. Display speed control kit and describe its purpose. B. Demonstrate. 1. How to make copy of layout 2. How to locate, mark, and center punch holes for drilling 3. How to drill holes on a drill press 4. How to remove burrs with a file 5. How to polish chassis with emery cloth Note: Stress safety. C. Assign students to perform steps noted on their chassis for grading.	A. Discuss full-wave rectification. 1. Explain disadvantages of half-wave rectification. 2. Describe methods to obtain full-wave rectification. 3. Illustrate and trace circuitry for a typical circuit. B. Material: Speed Control Kit: Kelvin Electronics #159-44
15. Inventory and test components for speed-control kit.	A. Display components package to be used for speed control kit. B. Review how to inventory compontents. C. Demonstrate pretesting of components 1. Resistor 2. Potentiometer 3. Line cord 4. Single pole, double throw switch 5. SCR 6. Capacitors D. Distribute work sheets 1. Have students inventory components using check list. 2. Have students pretest components and record results. 3. Have students submit their work for grading.	A. Discuss filtering in electronic circuits. 1. Purpose 2. How accomplished 3. Illustrate, trace, and describe a typical electronic circuit with capacitor filtering.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
16. Mount the components for the speed control kit.	A. Display chassis to be used for speed control kit. 1. Review importance of mounting components correctly. 2. Explain how each component is to be mounted. 3. Demonstrate mounting of components using basic hand tools. B. Assign students to mount components on their chassis using pictorial provided in kit as a guide. C. Have students submit their work for grading.	A. Review parallel circuits. 1. Relationship to electronics circuitry 2. Voltage values 3. Current values 4. Resistance values 5. Ohm's Law in parallel circuits for total values and part values.
17. Connect and test the potentiometer circuit on the speed control kit.	A. Display all components that comprise the potentiometer circuit. 1. Briefly describe function of each. 2. Describe how the wiring is to be done. B. Demonstrate. 1. How to wire the circuit 2. How to test the circuit with a VOM C. Assign students to three activities. 1. Wiring the circuit 2. Testing the circuit 3. Submitting results for grading	A. Review series - parallel circuits 1. Relationship to electronics circuitry 2. Voltage values 3. Current values 4. Resistance values 5. Ohm's Law in series - parallel circuits for total values and part values.

18. Complete the wiring and test the speed control kit.	A. Display the SCR and review its construction and function in the circuit. B. Demonstrate: 1. Wiring neon and SCR to complete the circuit. 2. Testing circuit with the VOM. 3. Operating a small load from the circuit. C. Assign the students to four activities. 1. Completing the wiring of the kit 2. Making tests with a VOM 3. Operating a load from the circuit. 4. Submitting work for a grade	A. Discuss applications for the kit being assembled. 1. Regulation of speed 2. Regulation of heat 3. Light dimming 4. Limitations
19. Locate faults and make repairs on electronic circuits.	A. Display electronic kit that has been pre-faulted 1. Describe typical faults that may occur. B. Demonstrate 1. Specific faults, relating their cause and describing remedy for each. C. Distribute kits prepared specfically for this job. Have students: 1. Identify faults. 2. Locate causes. 3. Prescribe remedies on assignment sheet. 4. Submit for grade.	A. Discuss typical faults that can occur in electronic circuits. 1. Opens, shorts, grounds in equipment. 2. Faults in wiring 3. Overloading 4. Repair and replacement of components.

Tasks	TEACHING CONTENT	
	Development of Skills	Development of Related Information
20. Locate faults and make repairs on electronic circuits - continued.	A. Display electronic kit with faults other than those found in previous job. B. Demonstrate 1. Specific faults, relating their cause and describing remedy for each C. Distribute kits prepared specifically for this job. Have students: 1. Identify faults 2. Locate causes 3. Prescribe remedy on assignment sheet 4. Submit for grade.	A. Review electronic components and circuitry. 1. Review of purpose, construction, operation of resistors, capacitors, diodes, SCR, switches

Unit IX: Wiring in Raceway

Level One: Signal Wiring
Suggested Time: *20 Hours / 30 Periods*

Performance Objectives

Upon completion of this unit the student will be able to:

- Cut and ream electrical metallic tubing to measurement with a hacksaw.
- Convert a schematic electrical diagram to a layout wiring diagram.
- Install a three-station, open-circuit fire alarm system, using selective ringing box and gong at each station. Use ridgid conduit as a raceway.
- Install a two-station closed-circuit alarm system with a "break-glass" fire alarm box at each station. The gongs operate from a set of batteries through a relay. Use ridgid conduit as a raceway.

	TEACHING CONTENT	
Tasks	Development of Skills	Development of Related Information
1. Cut and ream electrical metallic tubing to measurement with a hack saw.	A. Demonstrate 1. Preparing the hack saw for cutting E.M.T. a Choosing correct blade b Installation of blade 2. Cutting E.M.T. to measurement 3. Reaming E.M.T. B. Assign students to cut to measurement and ream the E.M.T. required for their next wiring job. C. Grade student's work.	A. Discuss the reasons for wiring in raceways. 1. Code requirements for construction of E.M.T.
2. Terminate E.M.T. to outlet boxes, and mount E.M.T. and boxes on work surface according to given lay-out and measurements.	A. Demonstrate 1. Removing knock-out from outlet boxes 2. Attaching connector to E.M.T. 3. Using locknut to attach connector to outlet box 4. Mounting outlet box on work surface B. Assign students to mount E.M.T. and boxes according to layout and measurements required for their next wiring job. C. Check and evaluate for correct layout and exact measurements.	A. Discuss outlet boxes. 1. Types 2. Uses 3. Code requirements 4. Nomenclature

3. Convert a schematic electrical diagram to a layout wiring diagram.	A. Demonstrate grouping wires in previously used open wiring diagrams, following layout of raceway. B. Assign students to convert the schematic wiring circuit of a four wire return call system into a layout wiring circuit for wiring into the raceway and outlet boxes; layout of task #2.	A. Discuss advantage of running wires in groups. 1. Fewer holes in structure 2. Fewer raceway runs B. Compare a selection of layout, schematic, and one-line diagrams. C. Discuss symbols used.
4. Install and connect a four-wire return call system, using E.M.T. as a raceway.	A. Demonstrate 1. Fishing conductors through raceways 2. Terminating conductors to equipment 3. Performing continuity test on conductors from box to box	A. Discuss code requirements 1. For conductors of different voltages in same raceway 2. For number of conductors in raceway 3. For number of conductors in boxes B. Stress need for sufficient lead lengths in boxes

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
5. Install a closed circuit burglar alarm protecting three points of entry using E.M.T. as a raceway.	A. Develop job circuit on board, following a pre-determined layout of raceway. B. Review job mounting procedures. C. Review job wiring methods D. Test installation 1. For proper operation 2. Mechanically and electrically secure connections 3. Secure mounting of equipment and raceway	A. Contrast and compare open and closed-circuit burglar alarm systems.
6. Cut and ream rigid conduit, using a hack saw and hand reamer.	A. Demonstrate 1. Selecting the correct saw blade 2. Installing the blade in the saw frame 3. Cutting the conduit to measurement 4. Reaming the conduit end. B. Assign students to cut conduit to measurements as required for next wiring job and ream all ends. C. Evaluate cuts and measurements.	A. Discuss code requirements for rigid conduit. 1. Construction 2. Use in fire alarms

7. Thread rigid conduit with a hand-operated stock and die.	A. Demonstrate construction of threading tool (stock & die.) B. Demonstrate cutting a thread. 1. Emphasize necessity for liberal use of cutting oil for lubrication and cooling of the dies. 2. Point out the proper length of thread. 3. Insist on use of pan to catch oil drippings and metal chips 4. Caution against oil spillage and need to clean it immediately. C. Have students thread their pre-cut conduit and check for correct procedure and length of thread.	A. Explain need for threading rigid conduit. B. Discuss various types of threaders used in the trade C. Discuss the composition and importance of cutting oil. D. Discuss safety factors 1. Avoidance of oil spillage 2. Catching of metal chips
8. Terminate rigid conduit to outlet boxes and mount on work surface according to layout and measurements for next wiring job	A. Demonstrate 1. Attachment of conduit to threaded boxes 2. Attachment of conduit to non-threaded boxes (knockout openings) 3. Use of locknuts 4. Importance of bushings B. Review mounting of outlet boxes C. Assign students to mount boxes and conduit according to required layout and measurements. D. Check layout for proper measurements and secure mounting.	A. Discuss and compare available types of rigid conduit. 1. Steel 2. Aluminium 3. Brass B. Discuss types of connectors. 1. Locknuts and bushings 2. Threadless squeeze connectors 3. Threadless set screw connectors

Tasks	TEACHING CONTENT: Development of Skills	TEACHING CONTENT: Development of Related Information
9. Install a three-station, open-circuit fire alarm system using a selective ringing box and gong at each station. Use rigid conduit as a raceway.	A. Develop layout drawing of job as required by layout of boxes and raceway. B. Review circuit wiring procedures and fishing conductors through raceways. C. Check wiring for proper operation and electrically and mechanically secure connection.	A. Compare open and closed-circuit fire alarm systems. 1. Discuss advantages of each.
10. Install a two-station closed circuit fire alarm system with a "break-glass" fire alarm box at each station. The gongs operate from a set of batteries through a relay. Use rigid conduit as a raceway.	A. Develop job layout circuit. B. Review mounting procedure for boxes, raceway and equipment. C. Review job wiring procedure. D. Test installation. 1. For proper operation 2. For secure connections 3. For secure mounting 4. For correct measurements	A. Discuss code and installation requirements for fire alarms and the value of fire alarm systems to society.

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Sample Lesson Plan

TOPIC Signal Wiring - Bells

AIM To install a four-wire return call system (to include a door opener).

INSTRUCTIONAL OBJECTIVE Upon completion of this lesson the student will be able to wire the circuit to specifications so that it operates correctly.

PREPARATION Colored chalk, equipment layout diagram (on chalkboard); equipment mounted on demonstration board.

MOTIVATION Why do you think a door opener is a convenience? Why should an electricain be able to wire a circuit for a door opener?

PRESENTATION	TEACHING PROCEDURE
1. Display door opener.	1. Describe the purpose of the door opener.
2. Review installation of door opener	2. Where is the door opener usually installed?
3. Develop job circuit on chalkboard.	3. Review: Job Wiring Procedures.
4. Develop, by questioning students, the wiring diagram from the layout diagram.	4. What type of conductors are used in bell wiring?
5. Select student to wire and operate demonstration circuit.	5. What is the advantage of the four-wire over the three-wire return call system?
6. Use demonstration board to explain troubleshooting procedures for circuit.	

SUMMARY Review circuit specifications

ASSIGNMENT Have students copy complete diagram into their notebooks

APPLICATION Have each student install circuit to specifications

REFERENCES Electrical Wiring, Albert Schuler.

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1981 Summer Curriculum Project

Appraisal Report

Trade Electricity: Signal Wiring - Level One

1. Suggested additions, with reasons why you recommend them:

   _____

   _____

2. Suggested deletions, with reasons why you recommend them:

   _____

   _____

3. Methods and materials used sucessfully:

   _____

   _____

4. Reaction of teachers and students to this curriculum:

   _____

   _____

5. Comments:

   _____

   _____

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